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Macroeconomic Performance of Currency Boards in Transition Economies

İ. Anıl Talaslı*

Open Market Operations Division
Central Bank of the Republic of Turkey
İstiklal Caddesi No:10
06100-Ankara, Turkey

anil.talasli@tcmb.gov.tr
Phone: 90-312-3091930

Abstract

The link between the exchange rate regime and macroeconomic performance has always been a debatable issue in international economics. This paper takes a critical look at this debate by focusing on the relative macroeconomic performance of currency boards against other exchange rate regimes in transition economies. The empirical findings of this paper show that, relative to floating regimes, currency boards in transition economies are associated with lower inflation and higher real GDP per-capita growth. Additionally, transition economies with currency boards experience higher real GDP per-capita growth compared to both pegged and floating regimes. According to the currency board experiences in transition economies, it can be stated that currency boards in Estonia, Lithuania and Bulgaria brought lower inflation and higher real GDP growth to these countries relative to the pre-currency board period.

JEL Classification: F33, P20
Keywords: Transition Economies, Exchange Rates, Currency Boards, Inflation, Growth.

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1. Introduction

Currency board arrangements became popular in recent years and four transition economies have established currency boards (Estonia, Lithuania, Bulgaria, Bosnia and Herzegovina). It should be noted that classic currency boards were different in some respects than the modern experiences. While the primary function of a classic currency board was to facilitate the trade between a colonial power and its dependent territories, the modern currency boards were introduced to address a range of specific economic challenges.[1]

There are already some empirical studies in the literature asserting that countries with fixed exchange rate regimes achieve lower inflation relative to countries with floating regimes.[2] Similarly, empirical studies about the macroeconomic performance of currency boards show that the countries operating under currency boards experience lower inflation and higher growth relative to countries with other exchange rate regimes.[3] Ghosh et al. (1998, 2000) conduct one of the most detailed multi-country studies in which they compare the inflation and growth performance of all IMF member countries over the period 1970-96. They conclude that countries with currency boards experienced lower inflation than either floating regimes or simple pegs, reflecting both a lower growth rate of money supply (a discipline effect) and faster growth of money demand (a confidence effect). Ghosh et al. (1998, 2000) also find that the better inflation performance of currency boards was not achieved at a cost of lower growth, indeed, output growth under currency boards exceeded growth under both floating and other pegged regimes. This paper basically aims to test whether if Ghosh et al. (1998, 2000)'s findings about the macroeconomic performance of currency boards is valid for transition economies or not. An empirical framework similar to Ghosh et al. (1998, 2000) is developed and the dataset in this study covers four regime types (pegged, intermediate, currency board, floating), twenty-seven transition economies over the period 1991-2000.

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[1] As Gulde et al. (2000) point out; these particular economic challenges are such as facilitating the transition from centrally planned to market economy (Estonia, Lithuania), stabilisation from high or hyperinflation (Bulgaria) and providing a stable institutional framework in post-war reconstruction (Bosnia and Herzegovina).

[2] See, for instance Ghosh et al. (1997, 2002).

[3] For empirical evidence, see Ghosh et al. (1998, 2000), McCarthy and Zanalda (1996) and Kwan and Lui (1996). It should be noted that Kwan and Lui (1996) compare the economic performance of Hong Kong under its currency board arrangement to its previous regime (floating regime). They conclude that the currency board in Hong Kong have lowered both inflation and output growth relative to the previous regime.

Like Ghosh et al. (1998, 2000), ordinary least squares (OLS) econometric technique is used in both inflation and growth regressions.

The remainder of the paper is as follows. Section 2 discusses the macroeconomic performance of currency boards by comparing the findings of several empirical studies. Since there are quite a few empirical studies about the macroeconomic performance of currency boards, Section 2 presents a brief literature review on the relationship between exchange rate regimes and economic performance. Section 3 begins with describing the dataset and discussing the evolution of key macroeconomic variables in transition economies. Section 3 also presents the quantitative results and their interpretations. Section 4 continues the discussion with currency board experiences in transition countries by focusing on each country's macroeconomic performance. Finally, Section 5 presents some brief concluding remarks.

2. Macroeconomic Performance of Currency Boards

This section will present a brief literature review of the currency board's macroeconomic performance. Majority of the papers were descriptive and they did not empirically examine the macroeconomic performance of currency board arrangements. The empirical studies can be classified into two categories: country specific studies and multi-country studies. Ghosh et al. (1998, 2000) conduct one of the most comprehensive multi-country studies about the macroeconomic performance of currency board arrangements. Ghosh et al. (1998, 2000) find that countries with currency boards experienced both lower inflation and higher GDP growth relative to floating regimes and simple pegs. They use the standard OLS (Ordinary Least Squares) econometric technique in their estimations by generating dummy variables for the exchange rate regimes. They conclude that both a lower growth of money supply (discipline effect) and a faster growth of money demand (credibility effect) lead to lower inflation rates in countries with currency boards compared to other regimes.[4] One significant finding of the paper that should be noted is that the better inflation performance of currency boards is not achieved at a cost of lower GDP growth.

[4] A fixed exchange rate regime -including a currency board arrangement- provides strong commitment which raises the political cost of monetary expansion (called the discipline effect). Additionally, fixed exchange rate regimes are credible which creates a second effect called the "confidence effect" that leads to a faster growth of domestic money demand.

Kwan and Lui (1996) make a country specific study (Hong Kong) in which they perform a simulation analysis to compare the macroeconomic performance of two periods. The full sample is divided into two periods according to the two exchange rate regimes: the free float period covers 1975:1 to 1983:3 and the currency board period covers 1983:4 to 1995:3.[5] Kwan and Lui (1996) find that both output growth and inflation are more stable during the currency board period than the free-floating years. They conclude that the currency board in Hong Kong have lowered both inflation and output growth.

McCarthy and Zanalda (1996) conduct an empirical study in which they compare the inflation and growth performances of ten Caribbean islands. They find that the Caribbean countries with currency board arrangements experience lower inflation and higher growth than other Caribbean countries with different exchange rate regimes.

As mentioned before, the empirical evidence linking inflation and output growth with the currency board arrangement is quite limited. On the other hand, there are many descriptive studies in the literature which mainly focus on the definition and basic features of currency boards, their benefits and costs or discuss currency board experiences from country cases.[6]

Since there are quite a few empirical studies about the macroeconomic performance of currency boards, it is worth discussing the other empirical studies which examine the link between the choice of the exchange rate regime and macroeconomic performance. The following two sub-sections will provide a brief literature review of the relationship between the exchange rate regimes and macroeconomic performance. Most of the studies take inflation and output growth as the main indicators of macroeconomic performance. Thus, the next sub-section will provide a review of the empirical findings on the link between exchange rate regime and inflation while the following sub-section will focus on the relationship between output growth and exchange rate regime.

[5] It should be noted that Kwan and Lui (1996) use quarterly data in their analysis. Each year is divided into four parts and each part covers three months.
[6] See, for instance Williamson (1995), Osband and Villanueva (1992), Perry (1997), Baliño et al. (1997), Bennett (1994), Enoch and Gulde (1998).

2.1. The Link between the Choice of the Exchange Rate Regime and Inflation

The relationship between exchange rate regimes and inflation remains a key issue in international economics. "Few questions in international economics have aroused more debate than the choice of exchange rate regime" (Ghosh et al., 1997). Orthodox discussion of the choice between fixed and floating regimes stems from the nature of the shocks. According to the standard models, flexible regimes can isolate the domestic economy if the shocks are mainly monetary and foreign. On the other hand, pegged regimes will be beneficial if the shocks are associated with unstable domestic monetary and financial policies because fixed regimes generate a discipline effect on the policy makers' actions.

Modern literature about the choice of exchange rate regime mainly discusses the trade-off between credibility and flexibility.[7] A country with a floating regime has an independent monetary policy which enables the country to deal with both domestic and foreign shocks more easily relative to fixed regimes. As discussed before, this flexibility reduces the credibility of the system. On the other hand, fixed regimes have less flexibility but higher degree of credibility relative to floating regimes. Accordingly, countries with fixed regimes tend to have lower inflation compared to countries operating under floating regimes.

The findings of the empirical studies about the link between exchange rate regime and inflation will now be discussed. Edwards (1993) conducts a study covering 52 countries over the period 1980-1989 and he finds that countries operating under fixed exchange rate regimes have lower inflation rates during the 1980s relative to countries with flexible regimes.

Ghosh et al. (1997) make one of the most detailed multi-country studies in which they analyse the link between the nominal exchange rate regime, inflation and growth.[8] They conclude that the inflation is both lower and more stable under fixed regimes reflecting both slower money supply (discipline effect) and faster money demand growth (credibility effect). Ghosh et al. (2002) expand this study by using a dataset which covers some 150 IMF member countries over 1970-1999. Their previous and updated studies yield similar results.

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[7] See, for instance Edwards (1996). Edwards (1996) develops a simple theoretical framework for examining the selection of an exchange rate regime. The analysis depends on the existence of a trade-off between credibility and flexibility.

[8] They use ordinary least squares (OLS) estimation technique by generating dummies for exchange rate regimes. The dataset covers three regime types (they also use a nine-way classification of exchange rate regime in their study), 136 countries over the period 1960-1990.

Domaç et al. (2001) conduct a similar analysis for transition economies. They claim that the use of standard econometric techniques such as OLS or 2SLS (two stage least squares) and the dummy variable approach will produce biased results. Thus, they employ a switching regression framework in order to examine whether the exchange rate regime have any effect on inflation.[9] The empirical results of the paper suggest that the exchange rate regime makes difference for inflation performance. Since it is not possible to compare the inflation performance of different exchange rate regimes by using the switching regression procedure, Domaç et al. (2001) perform simulations to determine whether a particular regime would have delivered lower (or higher) inflation relative to the one already established. The empirical findings of the paper indicate that transition economies with intermediate regimes may achieve lower inflation if they were to adopt a fixed regime. The results also suggest that switching from a floating regime to an intermediate arrangement may not deliver lower inflation. It should be noted that the intermediate regime includes cooperative systems, unclassified floats and floats with pre-determined range.

Little et al. (1993) make a study including 18 developing countries and they find that the fixed exchange rate regimes are not always associated with lower inflation.

2.2. The Link Between The Choice of The Exchange Rate Regime and Growth

It is generally argued that the exchange rate regime can affect economic growth either through the rate of factor accumulation (usually defined as investment) or through the growth rate of factor accumulation (increased productivity). Fixed exchange rate regimes reduce policy uncertainties, real interest rates and real exchange rate variability, thus they are usually associated with higher investment relative to other regimes.[10] On the other hand, fixed exchange rate regimes eliminate an important adjustment mechanism which leads to inefficient allocation of resources across sectors. Therefore, fixed regimes are generally assumed to have slower productivity growth relative to flexible regimes. The findings of the empirical studies about the link between exchange rate regime and growth will now be discussed.

Ghosh et al. (1997) find that GDP per-capita growth tends to be lower under fixed regimes but the difference is quantitatively small. They also state that

[9] They use Heckman's two-step procedure to estimate the switching regression.
[10] Ghosh and Pesenti (1994), Aizenman (1991) find that maintaining a fixed exchange rate regime leads to higher investment rates thus to faster output growth.

investment rates are highest under fixed exchange rates. According to the authors, lower "productivity growth"[11] under fixed regimes must have caused lower output growth compared to countries with floating exchange rates. Overall, Ghosh et al. (1997) fail to find a strong link between economic growth and exchange rate regimes. However, they find that the volatility of output is slightly higher under fixed regimes than it is under floating regimes.

Fisher et al. (1996) examine the link between exchange rate regime and growth by generating a dummy variable for the fixed exchange rate regime. They find that the coefficient on this dummy is positive and significant in the growth regressions.

Domaç et al. (2001) conduct an empirical study which covers 22 transition economies. Based on the empirical results of the paper, the authors conclude that it is not possible to make any judgement about a specific exchange rate regime being superior to the other in terms of growth performance. Economic growth is likely to depend on much more than just the exchange rate regime. Thus, there are many empirical studies which examine growth in transition economies by taking into account the role of structural reforms, macroeconomic variables and initial conditions.[12]

3. Empirical Evidence

3.1. Description of Data

The study is based on an annual dataset of all transition economies covering the period 1991-2000. International Monetary Fund (IMF)'s classification of countries is used in this study. IMF divides the world into three major groups: i) advanced economies, ii) developing countries, iii) transition economies. Countries in transition consist of 28 countries[13], however Yugoslavia and Serbia and Montenegro are excluded from this study because adequate data are not available. Thus, the dataset covers 27 transition economies over the period 1991-2000.[14]

It is worth mentioning the common features of transition economies. According to the IMF, these countries have two distinctive characteristics in common:

[11] They use trade growth (export growth plus import growth) in their empirical analysis as a measure of productivity growth.
[12] See, for instance, Berg et al. (1999) and Christoffersen and Doyle (1998).
[13] The list of transition economies is taken from the most recent IMF World Economic Outlook (September 2003) in which the IMF classifies the countries in transition as a major group. After September 2003, IMF starts to classify the countries into two groups: advanced countries; other emerging markets and developing countries.
[14] This study uses a panel data covering 27 transition countries and a time period of ten years.

i) transitional state of their economies from a centrally planned system to one based on market rules, ii) transformation of large industrial sectors whose capital stocks are mainly no longer in use. Table 3.1 presents the list of 27 transition economies that will be used in this study.[15]

Table 3.1
Countries in Transition by Region

Central and Eastern Europe		Commonwealth of Independent States and Mongolia
Albania	Slovak Rep.	Armenia
Bosnia and Herzegovina	Slovenia	Azerbaijan
Bulgaria		Belarus
Croatia		Georgia
Czech Republic		Kazakhstan
Estonia		Kyrgyz Republic
Hungary		Moldova
Latvia		Mongolia
Lithuania		Russia
Macedonia		Tajikistan
Poland		Turkmenistan
Romania		Ukraine
Serbia and Montenegro		Uzbekistan

Source: IMF World Economic Outlook, September 2003.

Transition economies have adopted a wide variety of exchange rate regimes over the period 1991-2000. The classification of exchange rate regimes is a crucial step in this study. Ghosh et al. (1997, 2002) classify exchange rate arrangements into three categories: i) pegged (or "fixed", these terms are used interchangeably in this paper), ii) intermediate and iii) floating regimes. Their classification is primarily based on the stated commitment of the central bank ("de jure" classification) as summarised in the IMF's annual report on Exchange Rate Arrangements and Exchange Rate Restrictions. Domaç et al. (2001) use the same classification approach and group the exchange rate regimes in three categories. In this paper, the exchange rate arrangements are classified into four categories by using a "de jure" classification approach: i) fixed, ii) currency board, iii) intermediate and iv) floating regimes. Since this paper is about the macroeconomic performance of currency boards in transition economies, currency board arrangements are classified separately from fixed regimes.[16] Classification of the exchange rate regimes is

[15] IMF divides the group of countries in transition into two regional sub-groups. IMF's regional classification is used in this table.
[16] Ghosh et al. (1997, 2002), Domaç et al. (2001) do not classify currency boards as a separate exchange rate regime in their studies. They include currency board arrangements in the fixed regimes category.

obtained from the IMF's Annual Report on Exchange Rate Arrangements. The currency board observations in the dataset are: Estonia (1992-2000), Lithuania (1994-2000), Bulgaria (1997-2000) and Bosnia and Herzegovina (1997-2000).[17] Further discussion of the exchange rate regime classification is provided in the next sub-section.

There are 213 observations in total. The dataset used in the regression analysis contains 27, 24, 17, and 145 observations under fixed, currency board, intermediate and floating regimes, respectively.

Data on real GDP growth, broad money growth, real GDP per-capita growth, total trade, population growth, nominal interest rate growth and trade growth are obtained from *World Development Indicators Database, World Bank*. Data on inflation is obtained from *IMF World Economic Outlook Database*. Transformed inflation rate is used throughout the regression analysis and it is calculated as "$\pi/(1+\pi)$".[18] Finally, data on investment (Gross Domestic Investment) to GDP ratio is obtained from *Global Development Network and Country at a Glance Tables, World Bank.* The dataset starts from the year 1991 because it is the starting year of transition for most of the transition economies. It should be noted that data on broad money growth is unavailable in the beginning of transition for the majority of transition countries.

3.2. Classifying Exchange Rate Regimes

Before analysing the link between currency board arrangements and their macroeconomic performance, all transition economies in the dataset should be classified according to their exchange rate regimes. An important question arises at this point: How should a country's exchange rate regime be classified? The textbook answer is simple: either the exchange rate is *fixed* or it *floats* (Ghosh et al., 2002:2). However, Ghosh et al. (1996) state that " beyond the traditional fixed-floating dichotomy, lies a spectrum of exchange rate regimes." There are important differences among exchange rate regimes and the traditional dichotomy can mask these differences.

On the other hand, Ghosh et al. (1998, 2000) take currency boards as a separate group of exchange rate regimes.

[17] IMF's annual report on exchange rate arrangements does not summarise currency board arrangements separately from the pegged regimes. However, the authorities in Estonia, Lithuania, Bulgaria and Bosnia and Herzegovina introduced currency boards and the authorities' stated commitments are enough to take the exchange rate regimes in these four countries as currency board arrangements.

[18] Ghosh et al. (1997, 1998, 2000, 2002) and Domaç et al. (2001) also transform the inflation rate (π) by calculating the transformed measure "$\pi/(1+\pi)$" which reduces the adverse effect of outliers.

3.2.1. Classification Approaches: De Jure vs. De Facto

Two options are available in classifying the exchange rate regimes. A "de jure" classification is based on the publicly stated commitment of the central bank. In other words, the de jure classification captures the formal commitment of the central bank, however it does not reflect the policies that are inconsistent with the commitment. On the other hand, a " de facto" classification has the advantage of being based on the observed behaviour of the nominal exchange rate regime to define the regime.[19]

Following Ghosh et al. (1997, 2002) and Domaç et al. (2001), a de jure classification approach is used for categorising regimes.[20] The de jure classification in this paper is based on the stated intentions of the monetary authorities as reported in the International Monetary Fund's Annual report on Exchange Rate Arrangements. Different from Ghosh et al. (1998, 2000), unclassified floats and target zones are taken as intermediate exchange rate regimes.[21] The fixed regime consists of single currency pegs, SDR pegs and other basket pegs. Currency board group contains the currency board arrangements in transition economies. The float group comprises of floats without pre-determined range and pure floats (See Appendix that presents the list of exchange rate regimes in transition economies between 1991-2000).

3.3. Evolution of Inflation and GDP Growth in Transition Economies

This section discusses the evolution of inflation and real GDP per-capita growth in transition economies over the period 1991-2000 by using the raw data. Table 3.2 summarises the mean values of the inflation rate, real GDP per-capita growth and transformed inflation rate.[22]

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[19] It is worth mentioning the article by Levy-Yeyati and Sturzenegger (2003) in which the authors construct an alternative classification approach by introducing a new de facto classification of exchange rate regimes.

[20] Ghosh et al. (1997) adopt a combination of de jure and de facto classification approaches in their study. It should be noted that Ghosh et al. (2002) use the de jure classification as their main method of categorising regimes but they also adopt de facto classification in order to make a comparison between these two approaches.

[21] The float category in Ghosh et al. (1998, 2000)'s study consists of target zones as well as pure floats.

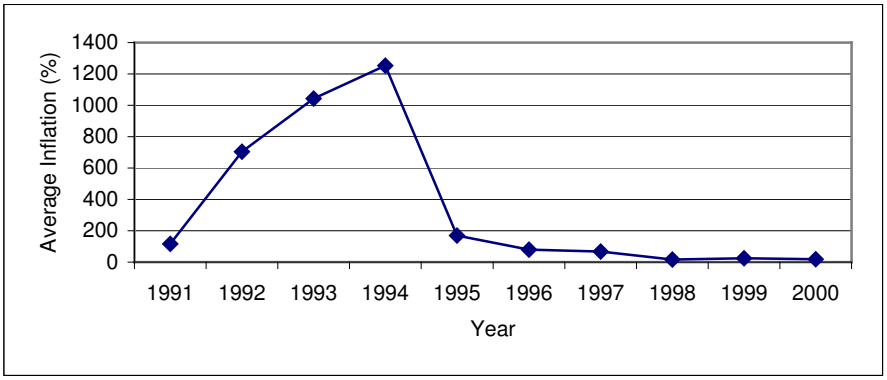
[22] Three regressions were run in which the inflation rate, real GDP per-capita growth and transformed inflation rate were dependent variables and year dummies were explanatory variables. Year dummies were used to calculate the annual means.

Table 3.2
Evolution of Inflation and Real GDP Growth in Countries in Transition

Year	Average Inflation (CPI, Annual %)	Average Real GDP Per-capita Growth (Annual %)	Average Transformed Inflation (Annual %)
1991	116.25	-10.45	0.49
1992	703.53	-15.15	0.73
1993	1043.3	-7.53	0.69
1994	1253.48	-7.21	0.57
1995	168.92	-0.15	0.39
1996	80.07	4.07	0.25
1997	66.61	3.85	0.2
1998	15.65	2.96	0.11
1999	25.36	3.28	0.13
2000	18.51	5.42	0.12

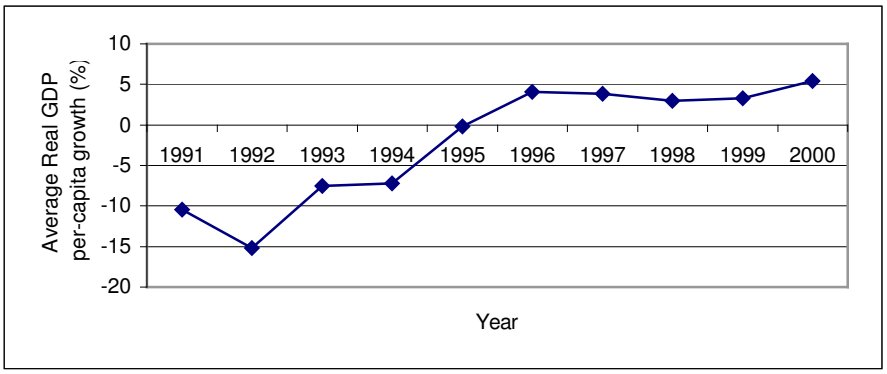
The following figures demonstrate the evolution of average inflation, real GDP per-capita growth and transformed inflation in all transition economies.

Fig. 3.1. Evolution of Average Inflation in Transition Economies



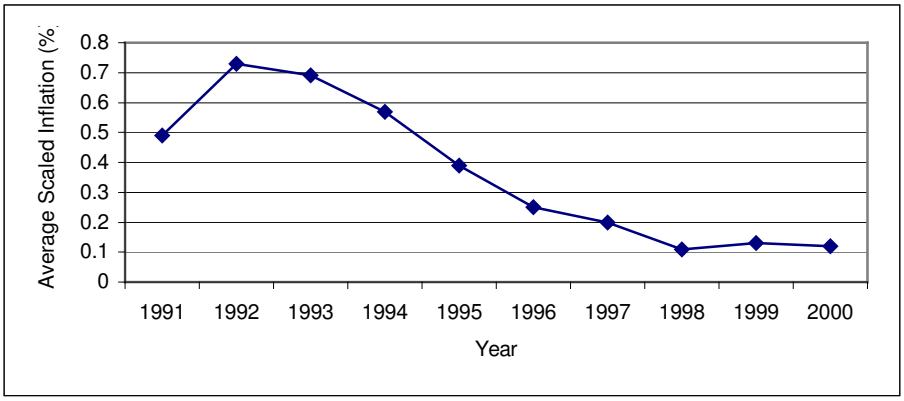
It can be easily seen from Figure 3.1 that the average inflation rate increases over the period 1991-1994 in which it exceeds 1000 percent in 1993 and 1994. After the four-digit average inflation rate in 1994, the mean value of the inflation rate starts to decline and follows a downward trend until the year 2000.

Fig. 3.2. Evolution of Average Real GDP per-Capita Growth in Transition Economies



The transition economies experience negative average real GDP per-capita growth rates until 1996. Between the periods 1996-1998, the average real GDP per-capita growth rates are almost constant displaying small deviations (less than 1 percent) over the years. Transition economies have an average real GDP per-capita growth rate between 2.96 percent and 4.07 percent per year over the period 1996-1998. The average real GDP per capita growth increases from 3.28 percent in 1999 to 5.42 percent in 2000.

Fig. 3.3. Evolution of Average Transformed Inflation in Transition Economies



Since the average inflation rates are extremely high especially between 1992 and 1994, transformed inflation rates can be used in calculating the annual means. The main objective of using a transformed inflation rate is to eliminate the effect of outliers. As mentioned before, the transformed inflation rate is calculated as "$\pi/(1+\pi)$" where π denotes the annual inflation rate in percentage. Figure 3.3 presents the evolution of the average transformed inflation which displays a

smoother curve compared to the one in Figure 3.1. It can be stated that, using a transformed inflation rate minimises the possible adverse effects of outliers in the sample.[23] The average transformed inflation rate starts to fall after it reaches its maximum value in 1992 and it declines continuously until 1998. It increases by a small amount in 1999 and falls again in 2000.

3.4. Inflation

3.4.1. Inflation Performance in Transition Economies

Only the exchange rate regime cannot explain the differences in inflation. A simple money demand function can be used in order to understand the factors underlying the differences in inflation performance across regimes.[24] A simple money demand function can be defined as:

$$mv / p = y^{\alpha} i^{-\beta} \qquad \alpha, \beta > 0 \tag{1}$$

Where m is broad money, p is the consumer price index, y is real output, i is the nominal interest rate and v is residual velocity. Re-arranged money demand function can be formed by taking logarithms and first differences[25]:

$$\Pi = \Delta logm - \alpha \Delta logy + \beta \Delta logi + \Delta logv \tag{2}$$

Where Π denotes the inflation.

Table 3.3 summarises the mean values of inflation, real GDP growth, broad money growth, growth rate of nominal interest rates and transformed inflation across different exchange rate regimes.

Table 3.3
Inflation Performance Across Different Exchange Rate Regimes (1991-2000)

Exchange Rate Regime	Average Inflation (Annual %)	Average Real GDP Growth (Annual %)	Average Broad Money Growth (Annual %)	Average Nominal Interest Rate Growth (Annual %)	Average Transformed Inflation (Annual %)
Fixed	656.58	-3.1	268.75	-9.55	0.5
Currency Board	105.74	3.12	44.032	-20.51	0.19
Intermediate	12.6	3.46	17.61	-3.08	0.1
Float	288.93	0.76	77.7	-11.34	0.3

Countries operating under fixed exchange rate regimes have the highest average inflation rate among other countries with different regimes. Most of the empirical

[23] Ghosh et al. (1998) state that the transformed measure of inflation is very close to the inflation rate at low levels of inflation, but it sharply reduces the effect of outliers in the sample.
[24] Ghosh et al. (1997) also use a simple money demand function to explain the differences in inflation performance across regimes.
[25] First differences are denoted by "Δ".

studies show that countries with fixed exchange rate regimes have lower average inflation relative to other regimes.[26] This general finding is obviously not valid for transition economies over the period 1991-2000, because most of the fixed exchange rate observations are from the period 1991-1994 which is associated with high levels of inflation (Table 3.2, Figure 3.1). Most of the countries with fixed exchange rate regimes experience extremely high inflation rates in the early years of the transition especially between 1992-1994 which is the main reason of why fixed regimes are associated with higher average inflation rates relative to other regimes. In addition, the broad money growth has the highest average (268.75 percent) in countries with fixed exchange rate regimes. Since, faster growth of broad money is associated with higher inflation, it may explain why countries operating under fixed regimes experience such a high average inflation rate. Transition economies with currency board arrangements have lower average inflation rate relative to fixed and floating regimes in transition economies. Finally, according to the basic statistics the intermediate regime has the best inflation performance among other regimes. Using the transformed measure reduces the slight differences of average inflation between exchange rate regimes, however the ranking remains unaltered. Transition economies with fixed regimes have the highest average inflation when the transformed measure is used.

On the growth side, only the transition economies with fixed exchange rate regimes experience negative average real GDP growth. The countries operating under intermediate regimes have the highest average real GDP growth (3.46 percent) and this is followed by countries with currency boards (3.12 percent). The bad growth performance of fixed exchange rate regimes can be explained by looking at Figure 3.2. It can be easily spotted from the figure that the transition economies experience negative real GDP growth rates, on average, between 1991-1995 which is the period that most of the fixed regime observations belong to.

[26] See, for instance, Ghosh et al. (1997, 1998, 2000). Ghosh et al. (1997) find that the mean inflation rate is lower in countries with pegged exchange rate regimes relative to countries with intermediate and floating regimes. Similarly, Ghosh et al. (1998, 2000) compare the average inflation under alternative exchange rate regimes (currency boards, other pegged and floating regimes) and find that economies with currency boards and other pegged regimes experience lower inflation, on average, compared to the countries with floating regimes.

3.4.2. Regression Analysis: Inflation

The transformed inflation rate will be regressed on four exchange rate dummies for pegged, currency board, intermediate and floating regimes, respectively. It is obvious that the inflation does not depend on the exchange rate regime alone, so the growth rate of money, output, nominal interest rate and openness[27] are chosen as other explanatory variables in the regression.[28] The regression is estimated twice: one of the regressions includes the broad money growth while the other does not. The coefficient estimates on exchange rate dummies reflect both the discipline and confidence effects in the regression which does not include the broad money growth as an explanatory variable. On the other hand, the coefficient estimates on exchange rate dummies will only capture the confidence effect in the regression which includes the broad money growth.

Table 3.4 presents the inflation regressions; one of which includes the growth rate of broad money. The regression including the broad money growth is said to be conditional on money growth.

Table 3.4
Inflation Regression

	Conditional on money growth		Unconditional on money growth	
	β	t-stat.[29]	β	t-stat.
Constant	0.19	2.01**	0.46	4.32***
Peg	-0.11	-1.23	-0.32	-3.17***
Currency board	-0.089	-1.07	-0.24	-2.58**
Intermediate	-0.094	-1.09	-0.29	-3.06***
Float	-0.056	-0.71	-0.20	-2.26**
Real GDP growth	-0.013	-5.70***	-0.021	-7.83***
Openness	0.0002	0.68	0.0002	0.38
Interest rate growth	-0.0003	-0.88	0.0008	1.73*
Broad money growth	0.0015	8.10***		
R^2 and number of observations	0.58	133	0.41	137

[27] Romer (1993) measures "trade openness" as the average share of imports in GDP or GNP. Similarly, Lee (1993) defines "natural openness" as the ratio of imports to GDP. On the other hand, Ghosh et al. (1997, 1998, 2000, 2002) measure trade openness as the ratio of exports plus imports to GDP. Following Ghosh et al. (1997, 1998, 2000, 2002), trade openness is measured as the ratio of exports plus imports to GDP in this study.

[28] In both inflation and growth regressions, debt-to-GDP ratio could be included to reveal the linkages between debt management and macroeconomic performance of transition economies. However, this robustness exercise cannot be done because of insufficiency of the data on debt-to-GDP ratio for the transition countries.

[29] Throughout the analysis, one, two and three asterisks denote significance at the 10, 5 and 1 percent levels respectively.

The coefficient estimates on exchange rate regime dummies are all negative but insignificant in the regression which includes the broad money growth. On the other hand, the coefficient estimates on the exchange rate dummies become significant when the broad money growth is excluded from the regression. According to the regression results, fixed exchange rate regimes are associated with 12 percentage points lower inflation (currency boards with 4 percentage points lower inflation and intermediate regimes with 9 percentage points lower inflation) compared to floating regimes. It should be noted that all the coefficients on exchange rate dummies have negative signs which indicates the negative association between inflation and all exchange rate regimes. The regression which includes the broad money growth does not provide satisfactory results because all the coefficient estimates on exchange rate dummies turn out to be statistically insignificant.[30] Therefore, some modifications were made in order to get better estimates.[31] However, all of these modifications did not provide satisfactory results. It is worth mentioning the robustness exercise done by including the interactions of the regressors with exchange rate dummies into the regression.[32] The aim of this test is to reveal the effect of each explanatory variable (real GDP growth, openness and interest rate growth) under different exchange rate regimes. According to the results of this test, it can be stated that no specific variable possesses different effects under different exchange rate regimes since all the coefficient estimates on these interaction variables are statistically insignificant.

3.5. Output Growth

3.5.1. Growth Performance in Transition Economies

Investment to GDP ratio is used to compare the investment among different exchange rate regimes.[33] Trade growth rate is used to compare the productivity[34] across exchange rate regimes because as Ghosh et al. (1997) state, growth of

[30] This might be mainly because of the high correlation between broad money growth and dependent variable (transformed inflation rate). The correlation between broad money growth and dependent variable is 66.01 percent.
[31] These modifications include adding year and country dummies into the regression and classfying the countries according to their differences in macroeconomic performance and creating dummies for each group by taking the years that have large effects for a specific group into account.
[32] The new variables are simply calculated as regressor_i times exchange rate dummy_j where i=1,2,3 and j=1,2,3,4.
[33] Pegged regimes are generally associated with higher investment compared to other regimes.
[34] Floating regimes are usually associated with faster productivity growth relative to other regimes.

external trade reflects a part of productivity growth.[35] Trade growth is calculated as the sum of export growth and import growth. Table 3.5 summarises the mean values of real GDP per capita, investment to GDP ratio and trade growth for pegged, currency board, intermediate and floating regimes.

Table 3.5
Growth Performance Across Different Exchange Rate Regimes (1991-2000)

Exchange Rate Regime	Average Real GDP per-capita Growth (%)	Average Investment/GDP (%)	Average Trade Growth (%)
Fixed	-3.64	25.10	18.71
Currency Board	3.26	23.55	15.92
Intermediate	3.63	29.34	20.93
Float	0.62	21.33	10.81

Real GDP per-capita growth averaged -2.17 percent a year: -3.64 percent for countries with pegged exchange rate regimes, 3.26 percent for countries operating under currency boards, 3.63 percent for countries with intermediate regimes and 0.62 percent for countries with floating regimes. According to the results, countries with intermediate regimes have the best growth performance among other regimes. The third and fourth columns of Table 3.5 report the mean values of investment to GDP ratio and trade growth. Both the average investment to GDP ratio and trade growth are found to be highest in countries with intermediate regimes. It should be noted that currency boards perform quite well with the second highest average real GDP per-capita growth (3.26 percent).

3.5.2. Regression Analysis: Growth

Real GDP per-capita growth is regressed on four exchange rate dummies for pegged, currency board, intermediate and floating regimes, respectively. Additionally, investment to GDP ratio, openness and population growth are chosen as other explanatory variables.

[35] "Part of the higher productivity growth is reflected in faster growth of external trade" (Ghosh et al., 1996:11).

Table 3.6
Reports the Results of the Growth Regression

	β	t-stat.
Constant	-10.41	-4.18***
Peg	6.52	2.88***
Currency board	14.57	5.84***
Intermediate	14.91	5.93***
Float	12.46	8.03***
Investment to GDP ratio	0.086	1.17
Openness	-0.03	-2.02**
Population growth	-0.15	-0.28
R^2 and number of observations	0.27	231

All of the coefficient estimates on exchange rate dummies become positive and highly significant. Countries with intermediate regimes have the best growth performance with 8.39 percentage points higher per-capita real GDP growth relative to pegged regimes. Countries operating under floating regimes also perform well and experience 5.94 percentage points higher per-capita real GDP growth relative to pegged regimes. Finally currency boards are associated with 8.05 percentage points higher real GDP per-capita growth compared to pegged regimes.

The robustness test is conducted by including the interactions of the regressors (investment to GDP ratio, openness, population growth) with exchange rate dummies into the regression in order to reveal the effect of each explanatory variable under different exchange rate regimes. The empirical results do not reveal anything significant that no certain explanatory variable has different effects under different exchange rate regimes.

4. Currency Board Experiences in Transition Economies

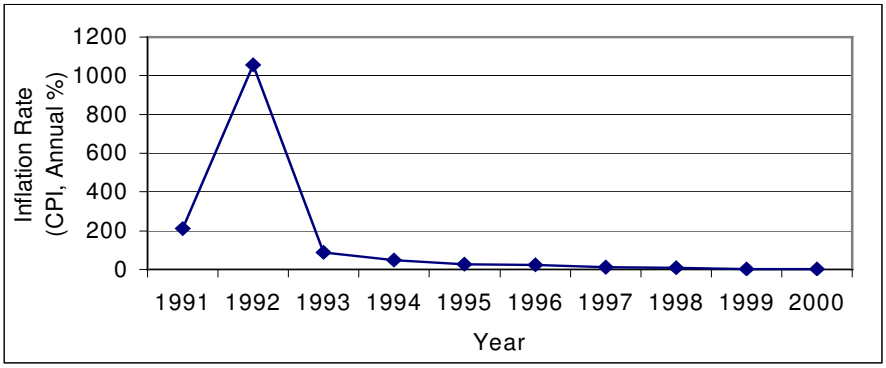
There are four transition economies which established currency boards and this section provides greater detail on these four currency board experiences: Estonia, Lithuania, Bulgaria and Bosnia and Herzegovina. Macroeconomic performance of each currency board will be discussed by comparing the periods before and after the introduction of the currency board.

4.1.1. Macroeconomic Performance of the Estonian Currency Board

The currency board in Estonia was established in June 1992 which was based on a fixed link between the Estonian kroon and Deutschemark, at a rate of 1DM = 8 Estonian kroon (Ghosh et al., 2000: 312). As Ghosh et al. (2000) state Estonian currency board has proved to be credible and Estonia's overall economic

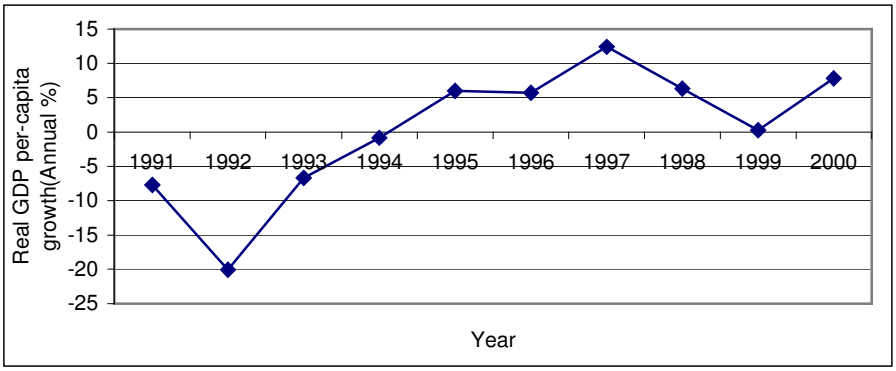
performance under the currency board arrangement has been quite strong. Estonia experienced a dramatic four-digit inflation rate in 1992 (Figure 4.1).

Fig. 4.1. Evolution of Inflation in Estonia



It can be easily noticed from Figure 4.1 that the inflation rate declined continuously after the introduction of the Estonian currency board. The inflation rate decreased from 210.6 percent in 1991 to 4 percent in 2000 and as Haan et al. (2001) state hyperinflation seems to be a thing of the past for Estonia. The economic performance of Estonia can be tested by analysing the evolution of real GDP per-capita growth (Figure 4.2).

Fig. 4.2. Evolution of GDP Growth in Estonia



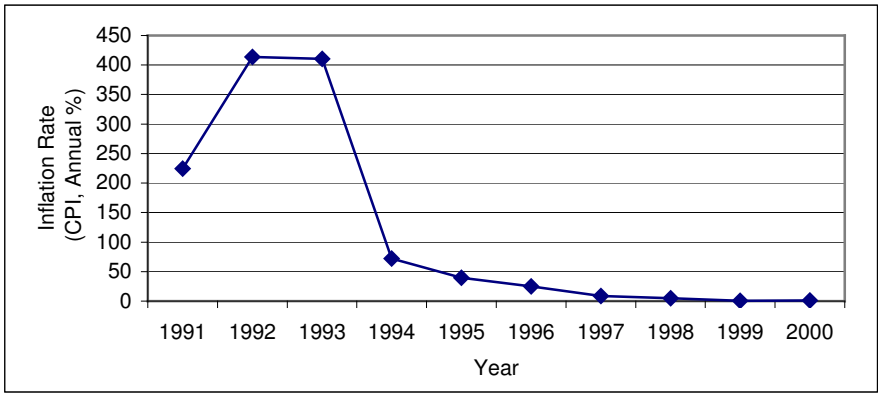
Estonia experienced negative growth rates in the early years of the 1990s, and real GDP per-capita has been positive since 1995. It can be spotted from the figure that the real GDP per-capita growth declined in 1998 and 1999.Per-capita real GDP growth decreased from 12.4 percent in 1997 to 6.29 percent in 1998 and 0.26 percent in 1999. This decline in GDP growth was mainly because of the Russian

Crisis in August 1998. Estonia broke the downward trend in GDP growth in 2000 by experiencing a real GDP per-capita growth rate of 7.81 percent.

4.2.1. Macroeconomic Performance of the Lithuanian Currency Board

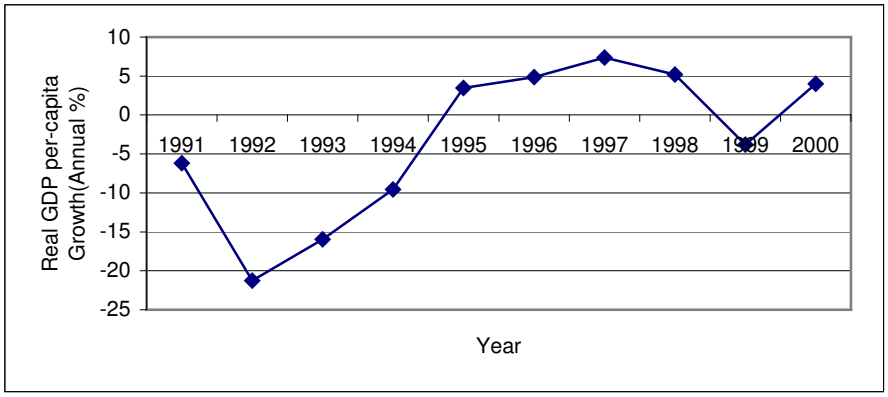
Lithuania introduced a currency board in April 1994[36] which was based on a fixed link between litas and US dollar (4 litas=1 US$). Lithuania suffered from 3-digit inflation rates before the introduction of the currency board (Figure 4.3).

Fig. 4.3. Evolution of Inflation in Lithuania



It can be noticed from the figure that the inflation declined continuously after the establishment of the currency board (1994). The inflation rate decreased from 224.7 percent in 1991 to 1 percent in 2000. Like Estonia, Lithuania experienced negative real GDP per-capita growth rates in the early years of 1990s (Figure 4.4).

Fig. 4.4. Evolution of GDP Growth in Lithuania

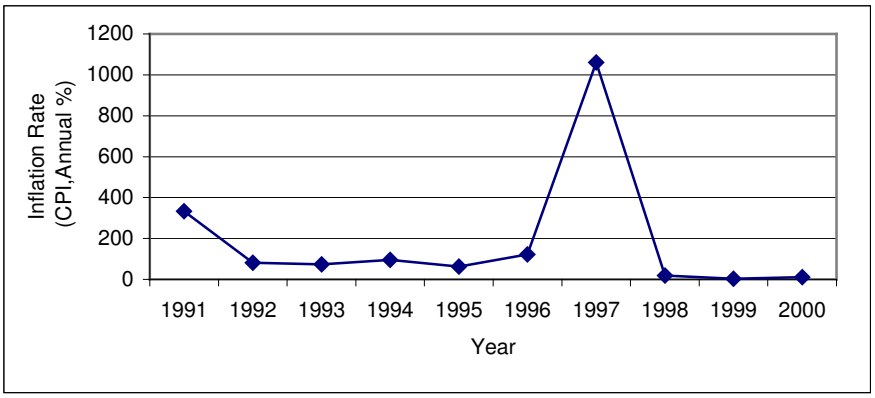


Strong economic growth, averaging 5.24 percent between 1995 and 1997, was interrupted in the second half of 1998 by the Russian crisis (Kuodis, 2000). Lithuania experienced a negative growth rate in 1999 because of the Russian crisis but it grew by 4 percent in 2000. In conclusion, the currency board brought low inflation and high growth to Lithuania.

4.3.1. Macroeconomic Performance of the Bulgarian Currency Board

The hyperinflation of late 1996 and early 1997 tilted the opinion in favour of a currency board arrangement (Ghosh et al., 2000: 317) by reducing the real value of domestic debt and improving the balance sheets of banks.[37] The new central bank law defining the key features of the currency board was passed by Parliament in June 1997 and Bulgaria introduced the currency board in July 1997. Bulgaria suffered from an extremely high inflation rate (1061.2 percent) in 1997 (Figure 4.5).

Fig. 4.5. Evolution of Inflation in Bulgaria



Following the establishment of the currency board, annual inflation fell to 18.8 percent in 1998. Annual inflation rate decreased from 333.5 percent in 1991 to 10.4 percent in 2000. By looking at Figure 26, it can be stated that the currency board brought low inflation to Bulgaria. After 1997, Bulgaria experienced lower inflation rates relative to the pre-currency board period. Bulgaria suffered from strongly negative real GDP per-capita growth rates both in 1996 (-9.66 percent) and 1997 (-6.55 percent) (Figure 4.6).

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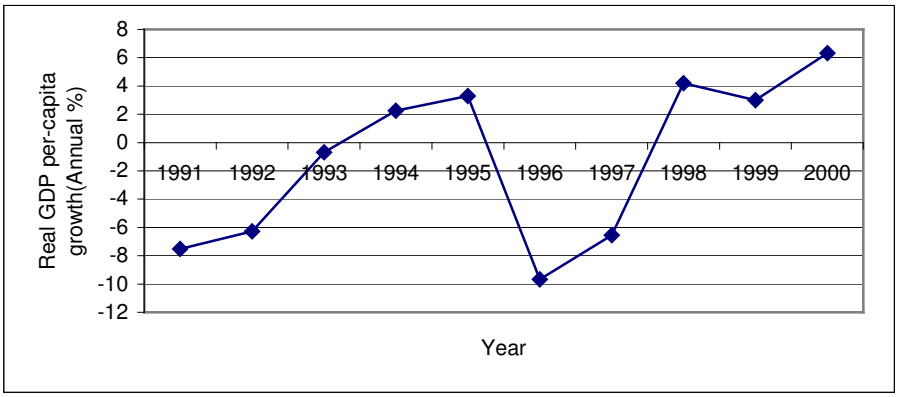
[36] Zettelmeyer and Citrin (1995) argue that Lithuanian currency board was introduced after Lithuanian government had proved its capacity to reduce inflation, adjust fiscally and stabilise the exchange rate.

[37] High inflation devalued the size of banks' domestic currency liabilities while it increased the real value of dollar-denominated bonds held by banks. These two effects of high inflation led to an improvement in the balance sheets of the banks.

Fig. 4.6. Evolution of GDP Growth in Bulgaria

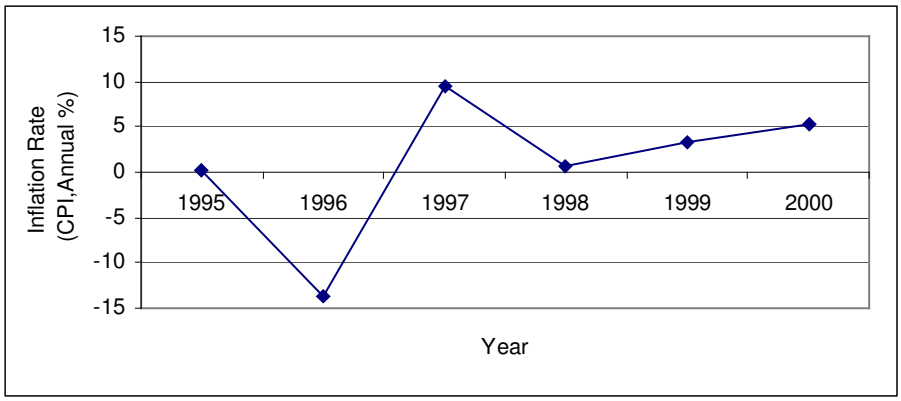


Real GDP per-capita growth turned positive in 1998 and remained positive until 2000. Real GDP per-capita growth increased from –7.53 percent in 1991 to 6.33 percent in 2000. It can be stated that the growth performance of Bulgaria has improved after the introduction of the currency board in July 1997.

4.4.1. Macroeconomic Performance of the Bosnian Currency Board

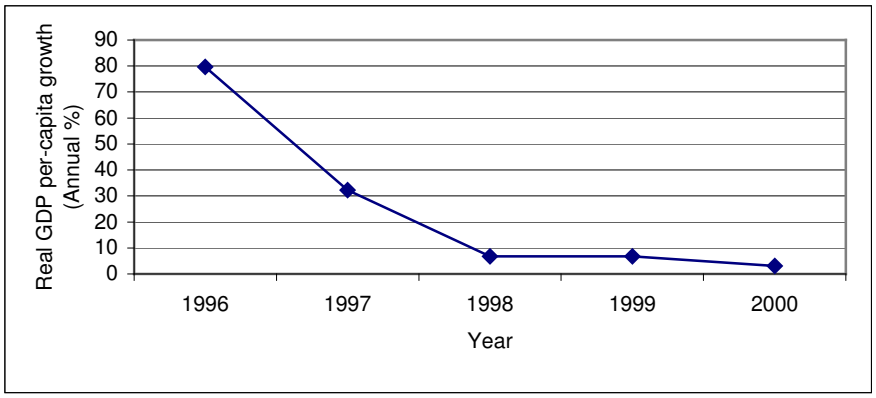
Schuler (2002) points out that "as stipulated in the Dayton Peace Accord, Bosnia and Herzegovina established a currency board linked to the German Mark on 1 August 1997". As Schuler (2002) states, statistics of the performance of the Bosnian economy remain sketchy as a result of the damage caused by the civil war. The inflation data is not available before 1995 (Figure 4.7).

Fig. 4.7. Evolution of Inflation in Bosnia and Herzegovina



By looking at the evolution of inflation in Bosnia and Herzegovina, it cannot be stated that the currency board brought low inflation. The inflation rate fell from 9.5 percent in 1997 to 0.6 percent in 1998, but it started to increase in 1999 and 2000. However, it should be noted that the inflation did not exceed the pre-currency board level. The data on GDP growth is available starting from 1996 (Figure 4.8).

Fig. 4.8. Evolution of GDP Growth in Bosnia and Herzegovina



It can be noticed from Figure 4.8 that the currency board did not improve the growth performance of Bosnia. Real GDP per-capita growth rate fell from 32.39 percent in 1997 to 3.13 percent in 2000. It should be kept in mind that the end of the post-war, economic rebound might have caused the sharp slowdown in real GDP per-capita growth.[38]

5. Conclusion

Although the link between the exchange rate regimes and economic performance is one of the most controversial issues in the literature, there are very few empirical studies providing some evidence on transition economies. As mentioned before, Domaç et al. (2001) conduct the most detailed empirical study in which they analyse the link between macroeconomic performance and exchange rate regimes in transition economies. Different from Domaç et al. (2001), this paper focuses on the comparative macroeconomic performance of currency boards against other exchange rate regimes in transition countries, which is an issue that has not been analysed empirically before. Although the empirical work in this study resembles

[38] High post-war (after 1995) growth reflects very low levels of pre-war growth. This will apparently lead to a rebound effect. When the post-war rebound effect started to diminish, the sharp slowdown in real GDP per-capita growth occurred.

the work of Ghosh et al. (1998), the main difference between the two is the classification of the exchange rate regimes. A four-way classification of exchange rate regimes (pegged, currency board, intermediate, floating) is used in this paper[39] while Ghosh et al. (1998) use a three-way classification by including target zones in the float category. Following Ghosh et al. (1997, 1998, 2000, 2002), ordinary least squares (OLS) econometric technique is used for estimating the inflation and growth regressions.[40]

Before examining the macroeconomic performance of currency boards in transition economies by using regressions, the evolution of inflation and GDP growth over the period 1991-2000 is discussed. It is found that the average inflation in transition economies increases over the period 1991-1994 in which it exceeds 1000 percent in 1993 and 1994. After the four-digit average inflation rate in 1994, the mean value of inflation starts to decline and follows a downward trend until 2000. In other words, transition economies experienced very high levels of inflation, on average, in the early years of the transition and the average inflation fell to two-digit levels. Transition economies suffered from strongly negative real GDP per-capita growth rates between 1991-1995 and then they started to experience positive average growth rates starting from 1996.

When the inflation performance across different exchange rate regimes is analysed, transition economies with fixed regimes are found to have the highest average inflation rate among countries with other regimes. Although this result is different than what most of the empirical studies predict[41], it can be explained by examining the raw data. Most of the transition economies with fixed exchange rate regimes experience extremely high inflation rates in the early years of the transition especially between 1992-1994 which is the period that the majority of the fixed regime observations belong to. Additionally, broad money growth has the highest average in transition economies with fixed regimes and this may be one of the reasons of why transition countries operating under fixed regimes experience the highest average inflation rate. On the growth side, only the transition economies

[39] As mentioned before, unclassified floats and target zones are taken as intermediate exchange rate regimes.

[40] According to Domaç et al. (2001), the use of OLS and 2SLS (two-stage least squares) will provide biased results. As mentioned before, Domaç et al. (2001) employ a completely different econometric method in which they use a switching regression model estimated by using a two-step Heckman procedure.

[41] For instance, Ghosh et al. (1997) find that the average inflation rate is lower in countries with pegged exchange rate regimes relative to countries either with intermediate or floating regimes.

with fixed exchange rate regimes experience negative average real GDP growth. This is mainly because most of the fixed regime observations belong to the period 1991-1995 in which the majority of the transition countries suffered from negative real GDP growth rates. According to the basic statistics, transition economies with currency boards have lower inflation and higher real GDP growth rates than the countries with fixed and floating regimes, on average. Additionally, transition countries with intermediate regimes have the best inflation and growth performance among other countries with different regimes.

The inflation regression is estimated twice in order to separate the discipline and the confidence effects. One of the regressions includes the broad money growth as explanatory variable while the other one excludes it. All of the coefficients on exchange rate dummies are found to be statistically insignificant in all inflation regressions including the broad money growth. Thus, it is not possible to separate the discipline and the confidence effects. The inflation regression excluding the broad money growth suggests that: i) transition economies either with currency boards or intermediate regimes achieve lower inflation rates relative to countries with floating regimes; ii) transition countries operating under fixed regimes experience lower inflation rates relative to countries either with currency boards or floating regimes.[42] One striking finding of this paper is the negative link between inflation and all exchange rate regimes because the entire significant coefficient estimates on exchange rate dummies have negative signs. In other words, all of the exchange rate regimes are negatively linked with inflation.

The growth regression implies that there is a positive link between adopting any of the exchange rate regimes and real GDP per-capita growth. In other words, all of the coefficients on exchange rate dummies are positive and highly significant in the growth regression. Empirical results of the regression suggest that: i) transition economies with currency boards experience higher real GDP per-capita growth relative to countries either with fixed or floating regimes; ii) transition countries with intermediate regimes have the best growth performance among countries with other regimes.

In conclusion, relative to floating regimes, currency boards in transition economies are associated with lower inflation and higher real GDP per-capita

[42] This result is different than the findings of Ghosh et al. (1998, 2000). Ghosh et al. (1998, 2000) conclude that currency boards experience lower inflation rates relative to other pegged regimes.

growth. Additionally, transition economies with currency boards experience higher real GDP per-capita growth compared to both pegged and floating regimes.

According to the currency board experiences in transition economies, it can be stated that currency boards in Estonia, Lithuania and Bulgaria brought lower inflation and higher real GDP growth to these countries relative to the pre-currency board period. On the other hand, this is not true for Bosnian currency board. As discussed before, this may be mainly because of the damage caused by the civil war.

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Appendix

Exchange Rate Regimes in Transition Economies

Country	IMF Membership Started	Exchange Rate Regime
(1)Albania	1991	1992 Fixed 1993-2000 Float
(2)Armenia	1992	1993 Fixed 1994-2000 Float
(3)Azerbaijan	1992	1993-1994 Fixed 1995-2000 Float
(4)Belarus	1992	1993 Fixed 1994-2000 Float
(5)Bosnia and Herzegovina	1992	1996 Fixed 1997-2000 Currency Board
(6)Bulgaria	1990	1991-1996 Float 1997-2000 Currency Board
(7)Croatia	1992	1994-2000 Float
(8)Czech Republic	1993	1994-1995 Fixed 1996-1997 Intermediate 1998-2000 Float
(9)Estonia	1992	1992-2000 Currency Board
(10)Georgia	1992	1993 Fixed 1994-2000 Float
(11)Hungary	1982	1991-1994 Fixed 1995 Float 1996-2000 Intermediate
(12)Kazakhstan	1992	1993 Fixed 1994-2000 Float
(13)Kyrgyz Rep.	1992	1994-2000 Float
(14)Latvia	1992	1993-1997 Float 1998-2000 Fixed
(15)Lithuania	1992	1993 Float 1994-2000 Currency Board
(16)Macedonia	1992	1994-2000 Float
(17)Moldova	1992	1993 Fixed 1994-2000 Float
(18)Mongolia	1991	1991-1993 Fixed 1994-2000 Float
(19)Poland	1986	1991 Fixed 1992-1995 Float 1996-2000 Intermediate
(20)Romania	1972	1991 Fixed 1992-2000 Float
(21)Russia	1992	1993-1997 Float 1998 Intermediate 1999-2000 Float
(22)Slovak Rep.	1993	1995 Fixed 1996-1998 Intermediate 1999-2000 Float
(23)Slovenia	1992	1994-2000 Float
(24)Tajikistan	1993	1995 Fixed 1996-2000 Float
(25)Turkmenistan	1992	1994-1995 Fixed 1996-2000 Float
(26)Ukraine	1992	1993-1997 Float 1998 Intermediate 1999-2000 Float
(27)Uzbekistan	1992	1995-2000 Float

Source: IMF Annual Report on Exchange Rate Arrangements. End of year observations.